PB90-234105

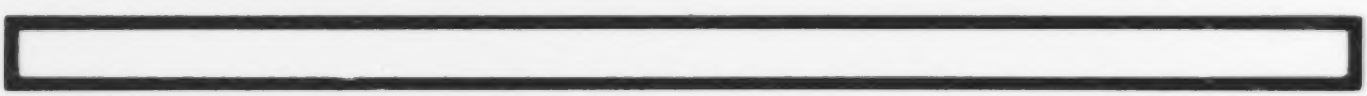
Final Best Demonstrated Available Technology (BDAT) Background Document for K046 (Addendum). Volume 10

Versar, Inc., Springfield, VA

Prepared for:

Environmental Protection Agency, Washington, DC

May 90



U.S. Department of Commerce
National Technical Information Service
NTIS

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO. EPA/530-SW-90-059J	2.	3. Recipient's Accession No. PB90-234 105
4. Title and Subtitle FINAL BDAT BACKGROUND DOCUMENT FOR K046 (ADDENDUM)			5. Report Date May 1990 6.
7. Author(s) Rosengrant/ Eby/OSW			8. Performing Organization Rept. No
9. Performing Organization Name and Address U.S. EPA Office of Solid Waste 401 M. Street SW Washington, DC 20460			10. Project/Task/Work Unit No. 11. Contract(C) or Grant(G) No. (C) 68-W9-0068 (G)
12. Sponsoring Organization Name and Address Versar, Inc.			13. Type of Report & Period Covered Background Document - 5/90 14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

This background document provides the Agency's technical support and rationale for the development of treatment standards for the constituents to be regulated for the above-mentioned wastes.

17. Document Analysis a. Descriptors

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report)	21. No. of Pages
RELEASE UNLIMITED	UNCLASSIFIED	0
	20. Security Class (This Page) UNCLASSIFIED	22. Price 0

(See ANSI-Z39.18)

OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)

EPA/530-SW-90-059J
PB90-234105

PB90-234105

FINAL BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT) BACKGROUND DOCUMENT FOR K046 (ADDENDUM)

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May 1990

Note: This background document is a proposed addendum to the August 1988 Final Best Demonstrated Available Technology (BDAT) Background Document for K046.

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NATIONAL TECHNICAL
INFORMATION SERVICE
SPRINGFIELD, VA 22161

ACKNOWLEDGEMENT

This document was prepared for the U.S. Environmental Protection Agency, Office of Solid Waste, by Versar Inc. under Contract No. 68-W9-0068. Mr. Larry Rosengrant, Chief, Treatment Technology Section, Waste Treatment Branch, served as the EPA Program Manager during the preparation of this document and the development of treatment standards for the K046 nonwastewater in the reactive subcategory, and all K046 wastewaters. The technical project officer for the waste was Ms. Monica Chatmon-McEaddy. Mr. Steven Silverman served as legal advisor.

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1. INTRODUCTION AND SUMMARY

Pursuant to section 3004(m) of the Resource Conservation and Recovery Act (RCRA) as enacted by the Hazardous and Solid Waste Amendments (HSWA) on November 8, 1984, the Environmental Protection Agency (EPA) is establishing best demonstrated available technology (BDAT) treatment standards for the listed waste identified in 40 CFR 261.32 as K046 (wastewater treatment sludges from the manufacturing, formulation, and loading of lead-based initiating compounds). If the treatment standards presented in this document are promulgated, compliance will be a prerequisite for placement of certain types of K046 waste in units designated as land disposal units according to 40 CFR Part 268. The effective date of these treatment standards would be June 9, 1990.

In August 1988, EPA established two subcategories for K046 waste--reactive and nonreactive--and promulgated a treatment standard for nonwastewaters in the nonreactive subcategory (see 53 FR 31138, August 17, 1988). The development of that treatment standard was described in the BDAT background document for the K046 nonreactive subcategory (USEPA 1988a). The treatment standard, a concentration-based standard for lead, was based on performance data from stabilization of a nonreactive K046 waste.

This final document is an addendum to the 1988 background document, it provides technical support for the promulgated treatment standards for K046 nonwastewaters in the reactive subcategory and for all K046 wastewaters. For the purpose of determining the applicability of the treatment standards, wastewaters are generally defined as wastes containing less than 1 percent (weight basis) total suspended solids* and

*The term "total suspended solids" clarifies EPA's previously used terminology of "total solids" and "filterable solids." Specifically, the quantity of total suspended solids is measured by Method 209C (Total Suspended Solids Dried at 103 to 105°C) in Standard Methods for the Examination of Water and Wastewater, 16th Edition (APHA, AWWA, and WPCF 1985).

less than 1 percent (weight basis) total organic carbon. Wastes not meeting this definition are considered nonwastewaters (USEPA 1989a).

The Agency is promulgating concentration-based standards for lead in the K046 wastes of interest. For the reactive subcategory nonwastewaters, the BDAT is deactivation followed by stabilization using Portland cement as a binder. The lead standard itself is based on data transferred from stabilization of a K046 nonreactive subcategory nonwastewater. For K046 reactive subcategory wastewaters, the BDAT is deactivation followed by alkaline precipitation and then settling and filtration. For the K046 nonreactive subcategory wastewaters, the proposed BDAT is alkaline precipitation followed by settling and filtration. The lead standard for both types of wastewaters is based on data transferred from treatment of a mixed K062, D007, and D008 metal-containing waste, which is thought to be similar to the K046 wastewaters.

Table 1-1 presents treatment standards for K046 wastes. The treatment standard for all K046 wastewaters is expressed in mg/l (parts per million on a weight-by-volume basis). The treatment standard for all nonwastewaters reflects the concentration of lead in the leachate from the Toxicity Characteristic Leaching Procedure (TCLP), and the units are mg/l. If the concentrations of lead in K046 wastes, as generated, are lower than or equal to the BDAT treatment standards when promulgated, then treatment is not necessary as a prerequisite to land disposal.

Table 1-1 BDAT Treatment Standards for K046 Wastes

Subcategory	Constituent	Maximum for any single grab sample: Nonwastewaters, Total composition (mg/kg)	Maximum for any single grab sample: Nonwastewaters, TCLP (mg/l)	Maximum for any single grab sample: Wastewaters, Total composition (mg/l)
Reactive	Lead	N/A	0.18[a]	0.037[a]
Nonreactive	Lead	N/A	0.18[b]	0.037[a]

N/A = Not applicable.

[a]These treatment standards are being promulgated in May 1990 under the Third Third Final rule.

[b]This treatment standard was promulgated in August 1988 (53 FR 31138, August 17, 1988).

2. INDUSTRY AFFECTED AND WASTE CHARACTERIZATION

As described in 40 CFR 261.32, K046 wastes are "wastewater treatment sludges from the manufacturing, formulation and loading of lead-based initiating compounds." This section discusses K046 wastes, their generation, and the industry affected by the land disposal restrictions that apply to them.

2.1 Industry Affected and Process Descriptions

K046 wastes are generated by the explosives industry, which is identified by the standard industrial classification (SIC) code 2892. SIC code 2892 facilities include both commercial firms and government-owned plants operated by private firms. In the August 1988 background document that supported the K046 treatment standard of the First Third rule (USEPA 1988a), the Agency estimated that 62 facilities in the United States were actively involved in the manufacture or use of lead-based initiating compounds and thus were potential generators of K046 wastes. The estimation was based on information retrieved in January 1987 from EPA's Hazardous Waste Data Management System (HWDMS) data base. More recent information developed by the EPA, Office of Solid Waste Listing Program indicates that only nine facilities manufacture and/or use lead-based initiating compounds and generate K046 wastes (Versar 1987a). Seven of these facilities manufacture lead-based initiating compounds and use them onsite for production of finished explosive products such as ammunition, blasting caps, and primers. The two other facilities purchase and use the compounds to produce finished explosive products. Table 2-1 lists the nine facilities along with their locations, products, and operations.

Lead-based initiating compounds are produced by reacting in aqueous solution a soluble lead salt with a soluble salt of an explosive anion. There are three major lead-based initiating compounds: lead azide, lead

Table 2-1 Generators of K046 Wastes

Company	Facility location	Products and operations
E. I. Du Pont	Pompton Lakes, NJ	Lead azide, blasting cap production
Remington Arms Co., Inc. (E.I. Du Pont)	Bridgeport, CT	Lead styphnate, ammunition
Remington Arms Co., Inc. (E. I. Du Pont)	Lonoke, AR	Lead styphnate, ammunition
Atlas Powder Co.	Tamaqua, PA	Lead mononitroresorcinate, fuses
IRECO Inc.	Port Ewen, NY	Blasting cap production
Ensign-Bickford Co.	Simsbury, CT	Blasting cap production
Federal Cartridge Corp.	Anoka, MN	Lead styphnate, ammunition
Olin Corp.	East Alton, IL	Lead azide, lead styphnate, ammunition
U.S. Army Lake City Ordnance Plant	Independence, MO	Ammunition

Reference: Questionnaire responses from industry, collected under authority of Section 3007 of RCRA, as reported in Versar 1987a.

styphnate, and lead mononitroresorcinate. Their manufacturing processes and the subsequent generation of K046 waste are summarized below.

- Lead azide manufacturing - A soluble azide salt is reacted with a soluble lead salt in aqueous solution. The product precipitates from solution, is collected by filtration, and then is washed, dried, and packaged. Process wastewaters are collected and treated with sodium nitrite and sodium carbonate to convert any lead azide present to lead carbonate and to destroy any azide ions. The resulting lead carbonate sludge is a K046 waste.

- Lead styphnate manufacturing - A soluble styphnate salt is reacted with a soluble lead salt in aqueous solution. The product precipitates from solution, is collected by filtration, and then is washed, dried, and packaged. Process wastewaters are collected and treated with sodium sulfide and sodium hydroxide to precipitate lead as the sulfide and to destroy any remaining styphnate ions. The resulting sulfide sludge is a K046 waste.

- Lead mononitroresorcinate products - A soluble mononitro-resorcinate is reacted with a soluble lead salt in aqueous solution. The product precipitates from solution, is collected by filtration, and then is washed, dried, and packaged. The wastewaters are collected and treated with sodium sulfide to destroy any mononitroresorcinate ions present and to precipitate lead as the sulfide. The resulting sulfide sludge is a K046 waste.

One of the facilities listed in Table 2-1 generates K046 from a fourth lead based initiator production process. This waste is contaminated with the molecular explosive tetracene. The wastewater sludge is chemically deactivated in a hot water bath with hydrogen sulfide (H_2S) to form a lead sulfide precipitate and a biodegradable dissolved organic compound. The sulfide reduces the nitro group to amine group. The amine group is then biodegradable.

K046 waste is also generated by load, assemble, and pack (LAP) operations. The lead-based initiating compounds and other components are fabricated into ammunition, primers, and blasting caps during LAP operations. Washdown waters from areas used for these operations are either treated to precipitate lead and destroy any explosive ions present or left undisturbed to allow any residues to settle out. The sludge separated from these "operations" is a K046 waste.

Filtrates and supernatants separated from the K046 sludges identified above are also K046 wastes under the "mixture" and "derived-from" rules. According to comments received on the proposed First Third rule and responses to questionnaires that were distributed under the authority of Section 3007 of RCRA (Versar 1987a), these filtrate and supernatant wastes are typically discharged to POTWs or surface waters under an NPDES permit, at which point they become subject to the requirements of the Clean Water Act.

2.2 Waste Characterization

Characterization data for K046 is shown in Table 2-2, lead concentrations is the predominant toxic metal in K046 wastes, range from as low as 0.59 ppm to as high as 197,500 ppm. Other BDAT list metals are not consistently present at concentrations above 10 ppm. The wastes have few organic components; no BDAT list volatile or semivolatile organic constituents have been detected in the sampled wastes, and the total organic carbon content is less than 500 ppm. Assuming that organics concentrations are negligible, percent water and total solids values should add to 100 percent.

In all cases, not enough information is available to ascertain whether the wastes are technically nonwastewaters or wastewaters. The Source 5 waste, however, is identified as a supernatant from treatment tanks from which settled K046 sludge is removed, and thus it is likely a wastewater. The Source 4 waste also appears to be a wastewater, based on its low total solids content (1.5 percent). Total solids concentrations for the tentatively identified nonwastewaters (Sources 1, 2, 3, and 6) range from 1.3 to 63 percent. Therefore, the nonwastewaters have water concentrations ranging from 37 to almost 99 percent. The tentatively identified wastewaters (Sources 4 and 5) have total solids (disolved plus suspended) concentrations ranging from 1.5 to 20 percent and thus water concentrations of 88 to almost 99 percent.

2.3 Determination of Waste Treatability Groups

Sometimes in the treatment of the wastewaters from which K046 wastes are generated, not all reactive components are adequately deactivated. Thus, to distinguish those wastes that are reactive as initially generated from those that are not, the Agency has divided K046 wastes into two subcategories, reactive and nonreactive. Treatment residuals and other "mixed" and "derived-from" K046 wastes are considered to be in the reactive subcategory if the K046 waste from which they are derived is reactive as initially generated.

As discussed in the preamble to the First Third Final rule, reactivity is to be determined by a testing protocol developed by the Department of Defense. Although this protocol does not contain official Office of Solid Waste analytical methods, the Agency believes that the protocol represents logical and safe analytical procedures for determining the characteristic of reactivity. This testing protocol is presented in Appendix A.

Both reactive and nonreactive K046 wastes are further subcategorized into nonwastewaters and wastewaters for the purpose of determining the applicability of the BDAT treatment standards. (See Section 1 for definitions of nonwastewaters and wastewaters.) Characterization data for various K046 wastes are presented in Table 2-2.

Note that the Agency believes that none of the characterization data in Table 2-2 represent K046 reactive subcategory wastes (i.e., Analytical laboratories do not normally handle reactive samples for safety reasons). However, because the treatment processes that first generate K046 wastes, whether reactive or nonreactive, are similar (the aim being to precipitate out lead in a nonreactive form while destroying explosive ions), the Agency believes that reactive K046 wastes, after deactivation by specialized incineration, will be similar to their nonreactive nonwastewater or wastewater counterparts. This subject is discussed further in Sections 3 and 4.

Table 2-2 Characterization Data for K046 Wastes

Constituent/parameter	Concentration (ppm, unless noted otherwise)									
	Source 1		Source 2		Source 3		Source 4		Source 5	Source 6
	Total	TCLP	Total	TCLP	Total[a]	TCLP	Total[a]	TCLP	Total	Total
BDAT list metals										
Antimony	0.022	<0.020	0.146-1.15	0.034-0.368	19-254	<0.2-2.0	<4	<0.19	-	-
Arsenic	<0.010	<0.010	<0.010-<0.10	<0.010-<0.10	6.2-38	<0.1-0.2	<2	<0.095	<0.02	-
Barium	<0.200	0.228	0.033-1.04	0.203-0.571	5.7-28,400	0.4-451	0.2	0.549	<1.0	-
Beryllium	<0.005	<0.005	<0.001	<0.001	<0.5-0.31	<0.005-0.01	<0.1	<0.005	-	-
Cadmium	<0.010	<0.010	<0.003-0.009	<0.003	1.4-1.8	<0.02-0.06	<0.03	<0.015	0.08-0.11	-
Chromium, total	<0.020	<0.020	<0.18-0.213	<0.004-0.018	4.0-21,600	<0.03-0.08	<0.6	<0.030	<0.14	-
Copper	<0.025	<0.025	<0.080-5.28	<0.004-0.008	6.0-1,233	<0.04-0.7	1.2	<0.040	-	1,500
Lead	967	103	63.2-1,960	0.058-0.415	43,400.0-197,500	3.5-1,870	27	7.26	0.59-200	4,500
Mercury	0.00084	<0.0003	0.0002-0.0076	<0.0004-0.006	<0.1-4.6	<0.002	<0.02	<0.002	<0.002	-
Nickel	<0.040	<0.040	0.064-0.165	0.029-0.053	4.9-25	<0.06-0.36	<72	<0.065	-	1,000
Selenium	<0.005	<0.005	<0.10	<0.25-<0.50	<0.5-340	<0.005	<0.5	<0.005	<0.05	-
Silver	<0.050	<0.050	<0.004-0.0073	<0.004	<0.2-<30	<0.05	<0.5	<0.025	<0.08	-
Thallium	<0.010	<0.010	<0.050-<0.20	<0.100	NA	NA	NA	NA	-	-
Vanadium	<0.050	<0.050	<0.003	<0.003-0.0034	<0.4-<4.0	<0.04	<0.4	<0.020	-	-
Zinc	0.295	0.335	0.159-3.47	0.086-0.18	57-3,776	<0.01-84.3	4.3	0.612	-	1,000
Other BDAT list constituents										
Volatile organics	NA	NA	<0.005-<0.40	NA	NA	NA	NA	NA	-	-
Semivolatile organics	NA	NA	<0.54-<2.7	NA	<0.01-<3.4	NA	NA	NA	-	-
Cyanide	NA	NA	NA	NA	NA	NA	4.49	5.26	<0.05-11.8	-
Sulfide	1.0	NA	NA	NA	NA	NA	NA	NA	1,480.-4,600	0.05-0.3

Table 2-2 (continued)

Constituent/parameter	Concentration (ppm, unless noted otherwise)									
	Source 1		Source 2		Source 3		Source 4		Source 5	Source 6
	Total	TCLP	Total	TCLP	Total[a]	TCLP	Total[a]	TCLP	Total	Total
Other parameters										
Water (%)	95	NA	NA	NA	NA	NA	NA	NA	-	95
Oil and grease	3.8	NA	NA	NA	NA	NA	NA	NA	-	-
Sulfate	190	NA	169-698	NA	NA	NA	NA	NA	-	-
Total organic carbon	461	NA	253-288	NA	NA	NA	NA	NA	-	-
pH	11.91	NA	12.65-13.42	NA	NA	NA	NA	NA	7.2-13.1	-
Total solids (%)	NA	NA	1.3-10.9	NA	24.5-63.1	NA	1.5	NA	4.78-20	-
Total dissolved solids	NA	NA	10,200-44,000	NA	NA	NA	NA	NA	-	-
Chloride	NA	NA	908-3,140	NA	NA	NA	NA	NA	-	-

[a]Data are reported on a wet weight basis.

NA = Not analyzed.
- = No available data.

References:

Source 1. USEPA 1988a, Tables 2-3 and 2-4.
Source 2. USEPA 1988d, LDR8-Reference 70.
Source 3. Versar 1987a, Table 5-1, Versar 1987b, Field nos. 18439-18452.
Source 4. Versar 1987a, Table 5-1, and Versar 1987b, Field nos. 18453-18457.
Source 5. USEPA 1988d, LDR8-References 59 and 69.
Source 6. Environ 1985, K046 data, Tables 1 and 2.

Table 2-3 Characterization Data for K046 Wastes Providing Range of the Regulated Constituent and Design Parameters for Nonwastewaters and Wastewaters

Parameters	Nonwastewaters		Wastewaters
	Total Concentration	TCLP	Total Concentration
Lead	27-197,500	0.058-1870	0.059-200
Water %	95	-	NA
Oil and grease	3.8	-	-
Total organic carbon	253-461	-	-
pH	11.91-13.42	-	7.2-13.1
Total solids %	1.3-63.1	-	1.5-20

Source: Table 2-2

NA = Not applicable.
- = Not available.

3. APPLICABLE AND DEMONSTRATED TREATMENT TECHNOLOGIES

This section identifies the treatment technologies that are applicable to K046 wastes and determines which, if any, of the applicable technologies can be considered demonstrated for the purposes of establishing BDAT.

To be applicable, a technology must theoretically be usable to treat the waste in question, or to treat a waste that is similar in terms of the parameters that affect treatment selection. To be demonstrated, the technology must be employed in full-scale operation for the treatment of the waste in question or a similar waste. Technologies available only at research facilities or in pilot- and bench-scale operations are not considered in identifying demonstrated technologies.

As discussed in Section 2, K046 wastes have been divided into reactive and nonreactive subcategories. The difference between the two types of wastes is that reactive subcategory wastes are reactive according to the testing protocol presented in Appendix A. Both types of wastes, however, contain metals and thus require treatment for metals.

3.1 Applicable Treatment Technologies

Applicable technologies for reactive K046 wastes include deactivation followed by metals treatment. Deactivation for nonwastewaters may entail chemical treatment, or specialized incineration. Stabilization technologies using various binder materials (e.g., Portland cement, lime/fly ash, and kiln dust) are applicable for treating metals in the deactivated nonwastewaters (see K046 Background Document, August 1988). Wastewaters can be deactivated by a variety of chemical treatments (e.g., adding carbonate and nitrite salts to a wastewater containing lead azide). The deactivated wastewaters can then be treated by alkaline precipitation followed by settling and filtration to remove metals.

Applicable technologies for treating metals in K046 nonreactive wastes are the same as those identified for the reactive wastes after deactivation, i.e., stabilization technologies for nonwastewaters and alkaline precipitation followed by settling and filtration for wastewaters.

As discussed in the August 1988 background document for K046 nonreactive subcategory wastes, metals recovery was not judged to be applicable because of the relatively low metals content.

3.2 Demonstrated Treatment Technologies

3.2.1 Nonwastewaters

EPA believes that "list" technologies for deactivation of K046 reactive subcategory nonwastewaters are demonstrated. Chemical treatment employing a variety of chemical reagents is used on a full-scale basis to eliminate the reactivity of "pre-K046" wastewaters, i.e., the reactive wastewaters from the manufacture or use of lead-based initiating compounds from which K046 wastes are initially generated. Reactive K046 nonwastewaters can be slurried so that they are amenable to the same treatment as these "pre-K046" wastewaters. Therefore, chemical treatment is a demonstrated deactivation technology for K046 reactive subcategory nonwastewaters.

Specialized incineration is being used full-scale on a variety of explosive-containing wastes (see the Final BDAT Background Document for Characteristic Ignitable Wastes (D001), Characteristic Corrosive Wastes (D002), Characteristic Reactive Wastes (D003), and P and U Wastes containing Reactive Listing Constituents (USEPA 1990c)). Because the Agency believes that these explosive-containing wastes are sufficiently similar to K046 reactive nonwastewaters in terms of reactivity characteristics, specialized incineration also is considered demonstrated for the K046 wastes.

The August 1988 background document for K046 already established stabilization technologies as demonstrated for metals in K046 nonreactive subcategory nonwastewaters. Because the Agency believes that K046 reactive subcategory nonwastewaters, once deactivated, will be no more difficult to treat than the nonreactive wastewaters for which treatment data are available. This belief is based on the premise that K046 wastes, whether reactive or nonreactive as initially generated, are produced by the manufacture/use of lead-based initiating compounds and that the techniques and components used in the manufacture/use do not vary such that they have an effect on the performance of stabilization. Lacking evidence that would disprove this belief, EPA has determined that stabilization technologies are demonstrated for treating metals in K046 reactive subcategory nonwastewaters. (For a detailed description of stabilization technologies, see EPA's Treatment Technology Background Document (USEPA 1989b).)

3.2.2 Wastewaters

The Agency knows of no full-scale technologies being used to deactivate K046 reactive wastewaters. However, in the generation of K046 wastes (as mentioned above), reactive wastewaters from the manufacture and use of the lead-based initiating compounds are being treated by various forms of chemical deactivation on a full-scale basis. The Agency believes that these "pre-K046" wastewaters, though likely more difficult to treat, are similar to true K046 reactive wastewaters in that they are expected to contain the same types of reactive ions that are amenable to chemical deactivation. Thus, chemical deactivation is considered demonstrated for K046 reactive subcategory wastewaters.

The Agency has not identified any facilities that definitely use alkaline precipitation followed by settling and filtration to remove metals from K046 wastewaters. (The K046 wastewaters generated concurrently with the K046 sludges are typically discharged to POTWs and

surface waters under NPDES permits and possibly are being treated by these technologies.) This treatment, however, is demonstrated for other wastewaters that are similar to K046 wastewaters in terms of available information on metals content and other factors that would affect selection of treatment. For example, this treatment has been demonstrated for a mixed K062, D007, and D008 waste that contained lead at concentrations up to 212 mg/l. (Performance data for the mixed waste are given in Section 4.) Thus, EPA considers alkaline precipitation followed by settling and filtration demonstrated for treatment of metals in K046 wastewaters. (Detailed descriptions of the technologies in this demonstrated treatment train are given in USEPA 1989b.)

4. PERFORMANCE DATA

Performance data, to the extent that they are available to EPA, include the untreated and treated waste concentrations for various constituents, values of operating parameters that were measured at the time the waste was being treated, values of relevant design parameters for the treatment technology, and data on waste characteristics that affect performance of the treatment technology.

Where data are not available on the treatment of the specific wastes of concern, the Agency may elect to transfer data on the treatment of a similar waste or wastes, using a demonstrated technology. To transfer data from another waste category, EPA must find that the wastes covered by this background document are no more difficult to treat (based on the waste characteristics that affect performance of the demonstrated treatment technology) than the treated wastes from which performance data are being transferred.

For treatment of K046 wastes, the Agency has three sets of performance data which are presented in the August 1988 background document. These data show treatment of a K046 nonreactive subcategory nonwastewater (generated from lead styphnate production) by (1) stabilization using a Portland cement binder, (2) stabilization using a lime/fly ash binder, and (3) stabilization using a kiln dust binder. Because performance data are not available from treatment of K046 reactive subcategory nonwaste- waters, EPA is transferring these available data from stabilization of the nonreactive nonwastewaters. The Agency believes that reactive wastes, once deactivated, will be no more difficult to treat than the nonreactive wastes for which treatment data are available. This belief is based on the premise that K046 wastes, whether reactive or nonreactive as initially generated, are produced by the manufacture/use of lead-based initiating compounds and that the techniques and components used in the

manufacture/use do not vary such that they have an effect on the performance of stabilization.

Although all three sets of performance data from testing K046 nonreactive nonwastewaters may be considered available for developing treatment standards for deactivated K046 reactive nonwastewaters, only data from the test using Portland cement are presented here in Table 4-1. As shown in the August 1988 background document, an analysis of variance statistical test on lead stabilization data determined that Portland cement is most effective in reducing the leachability of lead.

Because no performance data are available from treatment of K046 wastewaters by the sole identified demonstrated treatment (i.e., alkaline precipitation followed by settling and filtration), the Agency used data transferred from treatment of a mixed wastewater that contained K062, D007, and D008 wastes (see Table 4-2). The Agency believes that K046 wastewaters would be no more difficult to treat than this mixed wastewater because the K046 wastewaters have lower concentrations of metals, particularly lead, according to available characterization data. (Compare the "Source 4" and "Source 5" columns of Table 2-2, with the "treatment tank composite" columns of Table 4-2.)

Table 4-1 Performance Data for Stabilization Using Portland Cement on K046 Nonreactive Nonwastewater

Constituent/parameter	Concentration (ppm)					Applicable percent recovery (%)[a]
	Untreated waste		Treated waste TCLP			
	Total	TCLP	Sample #1	Sample #2	Sample #3	
BDAT list metals						
Antimony	0.022	<0.020	<0.17	<0.17	<0.17	95
Arsenic	<0.010	<0.010	<0.003	<0.003	<0.003	100
Barium	<0.200	0.228	1.8	1.8	1.8	100
Beryllium	<0.005	<0.005	<0.002	<0.002	<0.002	89
Cadmium	<0.010	<0.010	<0.005	<0.005	<0.005	96
Chromium	<0.020	<0.020	0.033	<0.020	0.030	95
Copper	<0.025	<0.025	<0.006	<0.006	0.019	81
Lead	967	103	0.072	0.100	0.062	77
Mercury	0.00084	<0.0003	0.0003	<0.0003	<0.0003	94
Nickel	<0.040	<0.040	<0.030	<0.030	<0.030	88
Selenium	<0.005	<0.005	<0.002	<0.002	<0.002	87
Silver	<0.050	<0.050	<0.006	<0.006	<0.006	25
Thallium	<0.010	<0.010	<0.0007	<0.0007	<0.0007	_[b]
Vanadium	<0.050	<0.050	<0.008	<0.008	<0.008	91
Zinc	0.295	0.335	0.036	0.027	0.112	96
Other parameters						
Sulfide	1.0	NA	NA	NA	NA	
Sulfate	190	NA	NA	NA	NA	
Oil and grease	3.8	NA	NA	NA	NA	
Total organic carbon	461	NA	NA	NA	NA	
pH	11.91	NA	NA	NA	NA	

NA = Not analyzed.

[a]The applicable percent recovery is the lower of the matrix spike recovery or matrix spike duplicate recovery for the particular metal in TCLP extracts unless both recoveries exceeded 100 percent (in which case, 100 percent recovery is applicable).

[b]Matrix spike recoveries fell below 20 percent, the BDAT Program's limit for acceptable data (see USEPA 1989a).

Note: Operating data are as follows: binder-to-waste ratio, 1.2; dry waste plus water weight, 600 grams, binder weight, 720 grams; and mixture pH, 12.35.

Source: USEPA 1988a, Tables 2-4 and 4-1, and USEPA 1988c, Table 6-4.

Table 4-2 Performance Data for Alkaline Precipitation, Settling, and Filtration of a Mixed K062, D007, and D008 Wastewater

Constituent/parameter	Concentration (ppm)							
	Sample #1		Sample #2		Sample #3		Sample #4	
	Treatment tank composite	Filtrate	Treatment tank composite	Filtrate	Treatment tank composite	Filtrate	Treatment tank composite	Filtrate
BDAT list metals								
Antimony	<10	<1	<10	<1	<10	<1	<10	NA
Arsenic	<1	<0.1	<1	<0.1	<1	<0.1	<1	<1
Barium	<10	<1	<10	<1	<10	3.5	<10	<10
Beryllium	<2	<0.2	<2	<0.2	<2	<0.2	<2	<2
Cadmium	13	<0.5	10	<0.5	<5	<0.5	<5	<5
Chromium (hexavalent)[b]	893	0.011	807	0.190	775	<NA	0.6	0.042
Chromium (total)	2,581	0.12	2,279	0.12	1,990	0.20	556	0.10
Copper	138	0.21	133	0.15	133	0.21	88	0.07
Lead	64	<0.01	54	<0.01	<10	<0.01	<10	<0.01
Mercury	<1	<0.1	<1	<0.1	<1	<0.1	<1	<1
Nickel	471	0.33	470	0.33	16,330	0.33	6,610	0.33
Selenium	<10	<1	<10	<1	<10	<1	<10	<10
Silver	<2	<0.2	2	<0.2	<2	<0.3	<2	<2
Thallium	<10	<1	<10	<1	<10	<1	<10	<10
Zinc	116	0.125	4	0.115	3.9	0.140	84	1.62
Other parameters								
Total organic carbon	2,700	NA	2,800	NA	500	NA	2,900	NA
Total solids	NA	NA	NA	NA	NA	NA	NA	NA
Total chlorides	NA	NA	NA	NA	NA	NA	NA	NA
Total organic halides	2,500	NA	3,600	NA	0	NA	900	NA

Table 4-2 (continued)

Constituent/parameter	Concentration (ppm)							
	Sample #5		Sample #6		Sample #7		Sample #8	
	Treatment tank composite	Filtrate	Treatment tank composite	Filtrate	Treatment tank composite	Filtrate	Treatment tank composite	Filtrate
BOAT list metals								
Antimony	<10	<1	<10	<1	<10	<1	<10	<1
Arsenic	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Barium	<10	<1	<10	<2	<10	<1	<10	<1
Beryllium	<2	<0.2	<2	<0.2	<2	<0.2	<2	<0.2
Cadmium	<5	<0.5	<5	<0.5	10	<0.5	<5	<0.5
Chromium (hexavalent)[b]	917	0.058	734	-[a]	769	0.121	0.13	<0.01
Chromium (total)	2,236	0.11	2,548	0.10	2,314	0.12	831	0.15
Copper	91	0.14	149	0.12	72	0.16	217	0.16
Lead	18	<0.01	<10	<0.01	108	<0.01	212	<0.01
Mercury	1	<0.1	<1	<0.1	<1	<0.01	<1	<0.1
Nickel	1,414	0.310	588	0.33	426	0.40	669	0.36
Selenium	<10	<1	<10	<1	<10	<1	<10	<1
Silver	<2	<0.2	<2	<0.2	<2	<0.2	<2	<0.2
Thallium	<10	<1	<10	<1	<10	<1	<10	<1
Zinc	71	0.125	4	0.095	171	0.115	151	0.130
Other parameters								
Total organic carbon	200	NA	700	NA	3,400	NA	5,900	NA
Total solids	NA	NA	NA	NA	NA	NA	NA	NA
Total chlorides	NA	NA	NA	NA	NA	NA	NA	NA
Total organic halides	0	NA	700	NA	1,900	NA	800	NA

Table 4-2 (continued)

Constituent/parameter	Concentration (ppm) Sample #9 Treatment tank composite	Sample #9 Filtrate	Sample #10 Treatment tank composite	Sample #10 Filtrate	Sample #11 Treatment tank composite	Sample #11 Filtrate	Applicable percent recovery (%)[a]
BOAT list metals							
Antimony	<10	<1	<10	<1	<10	<1.00	92
Arsenic	<1	<0.1	<1	<0.1	<1	<0.10	100
Barium	<10	<1	<10	<1	<12	<1.00	90
Beryllium	<2	<0.2	<2	<0.2	<2	<0.20	90
Cadmium	<5	<0.5	<5	<0.5	23	<5	87
Chromium (hexavalent)[b]	0.07	0.041	0.08	0.106	0.30	<0.01	100
Chromium (total)	939	0.10	395	0.12	617	0.18	68
Copper	225	0.08	191	0.14	137	0.24	83
Lead	<10	<0.01	<10	<0.01	136	<0.01	76
Mercury	<1	<0.1	<1	<0.1	<1	<0.10	90
Nickel	940	0.33	712	0.33	382	0.39	93
Selenium	<10	<1.0	<10	<1	<10	<1.00	48
Silver	<2	<0.2	<2	<0.2	<2	<0.2	76
Thallium	<10	<1.0	<10	<1	<10	<1.00	84
Zinc	5	0.06	5	0.070	135	0.100	98
Other parameters							
Total organic carbon	2,100	NA	0	NA	52	NA	NA
Total solids	NA	NA	NA	NA	NA	NA	NA
Total chlorides	NA	NA	NA	NA	NA	NA	NA
Total organic halides	0	NA	<300	NA	300	NA	NA

NA = Not analyzed.

[a]Applicable percent recoveries are given in Table 7-1 of USEPA 1988b.
[b]Hexavalent chromium was actually treated by chromium reduction prior to chemical precipitation and sludge filtration.

Note: Design and operating parameters are as follows:
pH during chromium reduction - 8.5 to 9.0
Reducing agent - ferrous iron
Ratio of reducing agent to hexavalent chromium - 3.2 to 10
pH during chemical precipitation - 8 to 10
Precipitation agent - lime
Filter type - vacuum filter

Source: USEPA 1986b and USEPA 1988b.

5. DETERMINATION OF BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT) FOR K046

This section presents the Agency's rationale for determining the best demonstrated available technology (BDAT) for K046 reactive nonwastewaters, reactive wastewaters, and nonreactive wastewaters. BDAT for K046 nonreactive nonwastewaters was determined to be stabilization using Portland cement as a binder (USEPA 1988a).

To determine BDAT for a particular waste, the Agency typically examines all available performance data on technologies that are identified as demonstrated to determine (using statistical techniques) whether one or more of the technologies performs significantly better than the others. If a technology is the sole demonstrated technology, then it is automatically "best." The best technology is then evaluated to determine whether it is "available," i.e., whether the technology is commercially available to any generator and whether it provides substantial treatment of the wastes, as determined through evaluation of accuracy-adjusted data, if available.

In determining whether treatment is substantial, EPA may consider the number and types of constituents treated, the concentrations of constituents in the treatment residuals, and the percent reduction of constituents achieved by treatment. Where performance data are not available for the waste in question, EPA may consider data on the performance of a similar waste, provided the similar waste is at least as difficult to treat.

In the case of K046 reactive nonwastewaters, the demonstrated technologies have been identified as follows: deactivation by chemical treatment, or specialized incineration, followed by stabilization using Portland cement, kiln dust, or lime/fly ash. The BDAT is stated as deactivation followed by stabilization using Portland cement. Lacking

sufficient data with which to compare performance of the various deactivation technologies, EPA is considering deactivation widely as best. Because any of the deactivation technologies are widely available and they provide substantial treatment (i.e., they eliminate the reactivity characteristics) if operated properly, deactivation is considered BDAT.

Stabilization using Portland cement is best for treating the metals as shown in the August 1988 background document (USEPA 1988a, Section 5). Stabilization using Portland cement as the binder is also commercially available, and it provides substantial treatment for lead in K046 nonreactive nonwastewaters (see Table 4-1). As discussed in Sections 3 and 4, the Agency believes that the K046 reactive nonwastewaters will be no more difficult to treat than the nonreactive nonwastewaters. Thus, stabilization using Portland cement is being proposed as BDAT for metals in reactive nonwastewaters.

Chemical deactivation followed by alkaline precipitation, settling, and filtration is the only identified demonstrated treatment for K046 reactive wastewaters. As the only demonstrated treatment, it is considered best. Because such a treatment train is commercially available, and because it would provide substantial treatment for both the reactivity characteristic and the metals (see the performance data for the mixed waste deemed similar in Section 4), the treatment train is being promulgated as BDAT for the K046 reactive subcategory wastewaters.

Because it is the only identified demonstrated technology for K046 nonreactive wastewaters, the alkaline precipitation, settling, and filtration train is considered best. Because it is commercially available and because it provides substantial treatment (again, see the performance data for the similar mixed waste in Section 4), this treatment is being promulgated as BDAT for the K046 nonreactive wastewaters.

6. SELECTION OF REGULATED CONSTITUENTS

This section presents the rationale for the selection of the regulated constituents in K046 wastes. Constituents selected for regulation must satisfy the following criteria:

1. They must be on the BDAT list of regulated constituents. (Presence on the BDAT list implies the existence of approved techniques for analyzing the constituent in treated waste matrices.)

2. They must be present in, or be suspected of being present in, the untreated waste. For example, in some cases, analytical difficulties (such as masking) may prevent a constituent from being identified in the untreated waste, but its identification in a treatment residual may lead the Agency to conclude that it is present in the untreated waste.

3. Where performance data are transferred from one constituent to others, the selected constituents must be easier to treat than the waste constituent(s) from which performance data are transferred. Factors for assessing ease of treatment vary according to the technology of concern. For instance, for incineration the factors include bond dissociation energy, thermal conductivity, and boiling point.

From the group of constituents that are eligible to be regulated, EPA may select a subset of constituents as representative of the broader group. For example, out of a group of constituents that react similarly to treatment, the Agency might name only those that are the most difficult to treat as regulated constituents for the purpose of setting treatment standards.

In the case of the K046 wastes, the Agency is regulating only lead. The Agency investigated the possibility of regulating other BDAT list metals that have been detected in K046 wastes, but has declined to do so because the available characterization data show that these metals are present in these wastes at relatively low concentrations. Also normally the BDAT technologies chosen should adequately treat, i.e., (immobilize) other BDAT list metals.

7. CALCULATION OF BDAT TREATMENT STANDARDS

The Agency bases treatment standards for regulated constituents on the performance of well-designed and well-operated BDAT treatment systems. These standards must account for analytical limitations in available performance data and must be adjusted for variabilities related to treatment, sampling, and analytical techniques and procedures.

BDAT standards are determined for each regulated constituent by multiplying the arithmetic mean of "accuracy-corrected" constituent concentrations detected in the treated waste by a "variability factor" specific to each constituent. The accuracy-corrected concentration for a constituent in a matrix is the analytical result multiplied by the correction factor (the reciprocal of the recovery fraction). For example, if Compound A is measured at 2.55 mg/l and the recovery is 85 percent, the accuracy-corrected concentration is 3.00 mg/l:

2.55 mg/l	x	1/0.85	=	3.00 mg/l
(analytical result)		(correction factor)		(accuracy-adjusted concentration)

Variability factors correct for normal variations in the performance of a particular technology over time. They are designed to reflect the 99th percentile level of performance that the technology achieves in commercial operation. Recoveries, accuracy correction, and variability factor determination and use are discussed further in EPA's Methodology for Developing BDAT Treatment Standards (USEPA 1989a).

The calculation of treatment standards for lead in K046 reactive subcategory nonwastewaters (after deactivation), reactive subcategory wastewaters (after deactivation), and nonreactive subcategory wastewaters is presented in Tables 7-1 and 7-2. The treatment standard for the nonwastewaters reflects the concentration of lead in the extract from the

Table 7-1 Calculation of Treatment Standards for K046 Reactive Subcategory Nonwastewaters

Sample No.	Untreated TCLP concentration (mg/l)	Treatment residual TCLP concentration, as analyzed (mg/l)	Accuracy correction factor	Treatment residual TCLP concentration, accuracy-corrected (mg/l)	Average of accuracy-corrected concentrations (mg/l)	Variability factor (VF)	Treatment standard (mg/l)
1	103	0.072	1/0.77	0.0935	0.101	1.76	0.18
2	103	0.10	1/0.77	0.130			
3	103	0.062	1/0.77	0.0805			

Table 7-2 Calculation of Treatment Standards for K046 Wastewaters, Reactive and Nonreactive Subcategories

Sample No.	Untreated concentration (mg/l)	Treatment residual concentration, as analyzed (mg/l)	Accuracy correction factor	Treatment residual concentration, accuracy-corrected (mg/l)	Average of accuracy-corrected concentrations (mg/l)	Variability factor (VF)	Treatment standard (mg/l)
1	64	<0.01	1/0.76	<0.0132	<0.0132	2.8	0.037
2	54	<0.01	1/0.76	<0.0132			
3	<10 [a]						
4	<10 [a]						
5	18	<0.01	1/0.76	<0.0132			
6	<10 [a]						
7	108	<0.01	1/0.76	<0.0132			
8	212	<0.01	1/0.76	<0.0132			
9	<10 [a]						
10	<10 [a]						
11	136	<0.01	1/0.76	<0.0132			

[a]No substantial treatment is indicated for these data points since the untreated concentrations fell below the detection limit. These data do not contribute to the treatment standard.

Toxicity Characteristic Leaching Procedure (TCLP) (51 FR 40643, November 7, 1986), and the units are mg/l (parts per million on a weight-by-volume basis). The treatment standard for wastewaters reflects the total waste concentration of lead in the wastewater; the units are mg/l. Note that the lead treatment standards are based on data that resulted from using EPA-approved methods SW-846 7421 (Atomic Absorption, Furnace Technique) for nonwastewaters and SW-846 7420 (Atomic Absorption, Direct Aspiration) for wastewaters (USEPA 1986a).

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APPENDIX A

DETERMINATION OF NONREACTIVE AND REACTIVE FORMS OF K046

APPENDIX A

DETERMINATION OF NONREACTIVE AND REACTIVE FORMS OF K046

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

OFFICE OF SOLID WASTE

SUBJECT: U.S. Army Procedures to Determine Reactivity

SEP 21 1992

FROM: David Friedman, Manager
Waste Analysis Program, WCB, HIWD (WH-565)

TO: Betty Willis, Region IV
Hazardous Waste Section

We have reviewed the test plan submitted by the U.S. Army Toxic and Hazardous Materials Agency for determining reactivity due to explosive properties. Negative results in the battery of tests outlined in their plan would be adequate proof that the soil sample is indeed not a reactive waste. OSW supports the use of this test plan and plans to recommend it for use by other generators facing such a problem.

If you need any assistance in evaluating the data generated during this study, please contact Florence Richardson of my staff. She can be reached at 755-9187.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region IV - Atlanta, GA

DATE: SEP 0 1 1981

SUBJECT: U. S. Army Toxic & Hazardous Materials Agency
Draft Procedures to Determine Reactivity

David Friedma.

FROM: Arthur G. Linton
Federal Activities Coordinator

TO: James H. Pinger, Director
Surveillance & Analysis Division

✓ James H. Scarbrough, Chief
Residuals Management Branch

The U. S. Army Toxic and Hazardous Materials Agency has requested that we review the three enclosures. The purpose of this procedure is to delineate the necessary tests, associated methods, and interpretation of results to determine whether contaminated soil and sediments are classified as reactive, due to their explosive properties. This information is necessary to determine what, if any, processing is required for final disposal of such soil or sediments.

The facility this procedure has been developed for is Milan Army Ammunition Plant, Milan, Tennessee. There are eleven lagoons located at this facility that have been used to process waters containing nitrobodies; specifically, what is classified as pink water. The closing out of these lagoons has a high priority within the Army and EPA because groundwater has been contaminated within the arsenal boundaries. There is an immediate need to develop a strategy to close out these lagoons, either by filling or treating the sediments.

Feel free to contact Mr. Robert A. Breschi, who is referred to in the enclosed documents. Once your review has been completed, we need to develop a mutual time during which we can discuss this procedure with Mr. Breschi and other representatives of the U. S. Army Toxic and Hazardous Materials Agency.

I am requesting that you respond to my request by September 11, 1981. I am targeting a meeting with the U. S. Army Toxic and Hazardous Materials Agency during the week of September 21.

Arthur G. Linton

Enclosures

EPA Form 1320-6 (Rev. 3-76)
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TEST PLAN TO DETERMINE REACTIVITY OF EXPLOSIVELY CONTAMINATED SOIL AND SEDIMENT*

I. PURPOSE

The purpose of this plan is to delineate the necessary tests, associated methods, and interpretation of results to determine whether a contaminated soil of sediment is classified as reactive due to its explosive properties. Such information is necessary to determine what (if any) processing is required prior to final disposal of such soil or sediment.

II. REFERENCE

a. Title 40 Code of Federal Regulations, Part 261, Para 261.23, Characteristic of Reactivity.

b. EPA Publication SW 846, Test Method for Evaluating Solid Waste, Subsection) 6-2; Definition of Explosive Materials (attached as Incl. 1).

c. Army Technical Bulletin 700-2, Chapter 3: Minimum Test Criteria for Bulk Explosive Compositions and Solid Propellant Compositions.

d. FONECONS with Dr. H. Matsuguma, Chief, Chemistry Branch, Energetic Materials Division, Large Caliber Weapons System Laboratory, U.S. Army Armament Research and Development Command, SAB.

III. BACKGROUND

Due to explosives production, employment, and disposal operations performed through the years at various military installations across the country, the Army owns property which contains potentially explosively contaminated soils and sediments. Efforts are underway to begin decontamination and close-out of such sites in compliance with Federal Environmental Regulations. Explosives, however, are governed by Ref. 2a, which restricts reactive materials from begin landfilled, including placement in a hazardous waste landfill. By regulation, then, every Army site which contains explosive residues, which range from low parts per million up to fifty percent in the worst cases, would require treatment prior to final disposal. Since many sites with low levels of contamination are not expected to exhibit any explosive properties, identifying such sites would remove from them the requirement to treat the residues as reactive wastes. Therefore, tests are provided in this plan which are suitable for determining whether a contaminated soil or sediment is reactive due to explosivity according to Environmental Protection Agency definitions.

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*Three sediment samples are obtained from each lagoon and analyzed for explosive concentration. One sample is taken near the waste water influent point, another near the effluent point, and the third sample is taken from the middle of the lagoon.

3. The Stability, Detonation, Impact, and Card Gap Tests are performed in a standard manner, although some minor modifications are required to accommodate preparation of environmental samples. The Spark Test is not a standard test for the Army, but with modification, can be performed in the same manner as the Detonation Test.

V. TEST EQUIPMENT AND MATERIALS

The following items are required to perform the necessary explosives tests on one field sample. Ancillary laboratory equipment is not included.

a. One Bureau of Explosives Impact Apparatus.

b. One ventilated explosion-proof oven equipped to continuously record temperature.

c. One blasting machine or equivalent.

d. Electric firing wire.

e. Electric blasting caps.

1. Five No. 8 electric blasting caps (contains 2 gms of 80/20 mixture mercury fulminate/potassium chlorate).

2. Three engineer special electric blasting caps.

f. Five electric match head igniters.

g. Two inch diameter by 1 inch long pressed pentolite pellet, National Stock No. 1375-00-991-8891, as required.

h. Solid lead cylinders 1-1/2 inch diameter by 4 inches high as required.

f. One piece of mild steel plate SAE 1010 to 1030, 1/2 inch thick by 12 inches square.

j. Mild steel plates (SAE 1010 to 1030) 6 x 6 inches x 3/8 inch as required.

k. Tubing, steel cold drawn seamless, mechanical, composition 1015, 1-7/8 inch 00, 0.219 inch wall thickness by 5-1/2 inch long, as required.

VI. SAMPLE PREPARATION:

A complete set of tests will require a five pound sample from each field sampling point. Samples will generally be received wet and possibly split into multiple containers for shipping purposes. The field sample will be prepared and split into laboratory samples as follows:

a. Recombine samples if necessary. Samples may be mixed while wet to achieve uniformity. Large chunks should be broken up, in a ball mill or mortar and pestle, using an operational shield if necessary.

b. Spark Test. Place a lead block (para. 5h) on the steel plate (para. 5i). Using a sample from para. 6d(1), make a small depression in the sample with stick or pencil, insert an electric match head igniter (para. 5f) into the depression and secure (tape) the igniter wires to the cup for stability. Place the cup on the lead block, connect the firing circuit, and remotely initiate. Deflagration will be evidenced by the energetic burning of the sample. Detonation of the sample will cause mushrooming of the lead block. Repeat the test five times or until evidence of a deflagration or detonation occurs, whichever is less. Record results on data sheet.

c. Detonation Test. Place a lead block (para. 5h) on the steel plate (para. 5i). Using a sample from para. 6d(1), press a hole about half the length of the blasting cap into the center of the sample using a pencil, then insert a No. 8 blasting cap into the sample. A wood block with a hole drilled in it similar to Fig. 2 may be used to support the blasting cap. Place the sample onto the lead block, connect the firing circuit, and remotely initiate. Detonation of the sample will cause mushrooming of the lead block. Repeat the test five times or until detonation occurs, whichever is less. Record results on a data sheet.

d. Impact Sensitivity Test: Conduct ten individual tests using one sample (para. 6d(2)) per test in the Bureau of Explosives Impact Apparatus. Place a 10 mg sample in the cup assembly. Drop the weight from the maximum height of the machine. Observe the result and record on the data sheet. Conduct tests at an ambient temperature of 25°C 5°C. Insure cup and anvil are thoroughly cleaned and dried between test runs.

e. Gap Test

1. Assemble the following items for each test to be conducted:

   a. One sample prepared according to para. 6d(3).

   b. Two pentolite pellets (para. 5g).

   c. One engineer's special electric blasting cap, J2 (para. 5e(2)).

   d. Blasting machine and firing wire (para 5c. and d).

   e. One 5 x 6 inch steel plate (para. 5j).

   f. Plastic material, 1/16 inch thick cut into 1/2 inch squares.

2. Arrange the materials as shown in Fig. 2. The witness plate is supported on two edges, about 6 inches above ground surface. The small plastic squares are placed on the plate to support the pipe and maintain a 1/16 inch air gap. The squares should be under the edge of the pipe, rather than under the explosive. The pentolite boosters are then placed on top of the sample as shown in Fig. 2, except that the gap cards and the cardboard tube are not used. The blasting cap is then placed on top of the pentolite (with a wood support ring) and remotely detonated. Detonation of the sample is indicated when a clean hole is cut in the witness plate. This test is performed three times or until a detonation occurs, whichever is less. Results are recorded on the data sheet.

SW 84B, DATED MAY 1980
"TEST METHODS FOR EVALUATING SOLID WASTE"

SUBSECTION 6.2

DEFINITION OF EXPLOSIVE MATERIALS

For purposes of this regulation, a waste which is a reactive waste by reason of explosivit is one which meets one or more of the following descriptions:

1. Is explosive and ignites spontaneously or undergoes marked decomposition whe subjected for 48 consecutive hours to a temperature of 75°C (167°F).

2. Firecrackers, flash crackers, salutes, or similar commercial devices which produce c are intended to produce an audible effect, the explosive content of which exceeds 1 grains each in weight, and pest control bombs, the explosive content of which exceed 18 grains each in weight; and any such devices, without respect to explosive conten which on functioning are liable to project or disperse metal, glass or brittle plasti fragments.

3. Fireworks that combine an explosive and a detonator or blasting cap.

4. Fireworks containing an ammonium salt and a chlorate.

5. Fireworks containing yellow or white phosphorus.

6. Fireworks or fireworks compositions that ignite spontaneously or undergo marked decomposition when subjected for 48 consecutive hours to a temperature of 75°C (167°F).

7. Toy torpedoes, the maximum outside dimension of which exceeds 7/8 inch, or toy torpedoes containing a mixture of potassium chlorate, black antimony and sulfur with an average weight of explosive composition in each torpedo exceeding four grains.

8. Toy torpedoes containing a cap composed of a mixture of red phosphorus and potassium chlorate exceeding an average of one-half (0.5) grain per cap.

9. Fireworks containing copper sulfate and a chlorate.

10. Solid materials which can be caused to deflagrate by contact with sparks or flame such as produced by safety fuse or an electric squib, but can not be detonated (see Note 1) by means of a No. 8 test blasting cap (see Note 2). Example: Black powder and low explosives.

11. Solid materials which contain a liquid ingredient, and which, when unconfined (see Note 3), can be detonated by means of a No. 8 test blasting cap (see Note 2); or which can be exploded in at least 50 percent of the trials in the Bureau of Explosives' Impact Apparatus (see Note 4) under a drop of 4 inches or more, but can not be exploded in more than 50 percent of the trials under a drop of less than 4 inches. Example: High explosives, commercial dynamite containing a liquid explosive ingredient, primarily nitroglycerin component.

21. Grenades. Grenades, hand or rifle, are small metal or other containers designed to be thrown by hand or projected from a rifle. They are filled with an explosive or a liquid, gas, or solid material such as a tear gas or an incendiary or smoke producing material and a bursting charge.

22. Explosive bombs. Explosive bombs are metal or other containers filled with explosives. They are used in warfare and include airplane bombs and depth bombs.

23. Explosive mines. Explosive mines are metal or composition containers filled with a high explosive.

24. Explosive torpedoes. Explosive torpedoes, such as those used in warfare, are metal devices containing a means of propulsion and a quantity of high explosives.

25. Rocket ammunition. Rocket ammunition (including guided missiles) is ammunition designed for launching from a tube, launcher, rails, trough, or other launching device, in which the propellant material is a solid propellant explosive. It consists of an igniter, rocket motor, and projectile (warhead) either fused or unfused, containing high explosives or chemicals.

26. Chemical ammunition. Chemical ammunition used in warfare is all kinds of explosive chemical projectiles, shells, bombs, grenades, etc., loaded with tear, or other gas, smoke or incendiary agent, also such miscellaneous apparatus as cloud-gas cylinders, smoke generators, etc., that may be utilized to project chemicals.

27. Boosters, bursters, and supplementary charges. Boosters and supplementary charges consist of a casing containing a high explosive and are used to increase the intensity of explosion of the detonator of a detonating fuse. Bursters consist of a casing containing a high explosive and are used to rupture a projectile or bomb to permit release of its contents.

28. Jet thrust units or other rocket motors containing a mixture of chemicals capable of burning rapidly and producing considerable pressure.

29. Propellant mixtures (i.e., and chemical mixtures which are designed to function by rapid combustion with little or no smoke).

Note 1: The detonation test is performed by placing the sample in an open-end fiber tube which is set on the end of a lead block approximately 1-1/2 inches in diameter and 4 inches high which, in turn, is placed on a solid base. A steel plate may be placed between the fiber tube and the lead block.

Note 2: A No. 8 test blasting cap is one containing two grams of a mixture of 80 percent mercury fulminate and 20 percent potassium chlorate, or a cap of equivalent strength.

Note 3: "Unconfined" as used in this section does not exclude the use of a paper or soft fiber tube wrapping to facilitate tests.

REACTIVITY/EXPLOSIVITY TEST DATA SHEET

Installation _____

Sample Number and Location _____

Explosive Components and Concentrations _____

Test Result: Sample is Reactive/Non-Reactive (circle one) _____

Detonation Test

	Exploded Yes	Exploded No	Deflagration Yes	Deflagration No
No. 8 Blasting Cap Test I	____	____	____	____
Test II	____	____	____	____
Test III	____	____	____	____
Test IV	____	____	____	____
Test V	____	____	____	____

Samples: Five 4 oz. cups Test: One blasting cap per sample.

Spark Test

	Exploded Yes	Exploded No	Burned Yes	Burned No
Electric Match Head Igniter	____	____	____	____
Test I	____	____	____	____
Test II	____	____	____	____
Test III	____	____	____	____
Test IV	____	____	____	____
Test V	____	____	____	____

Samples: Five 4 oz. cups

Thermal Stability Test

Explosion Yes	Explosion No	Ignition Yes	Ignition No	Marked Decomposition Yes	Marked Decomposition No
____	____	____	____	____	____

Samples: One 4 oz. cups Test: 48 hours at 75°C in vented oven.

Card Gap Test Samples: 3 Tubes Detonation: Yes ____ No ____

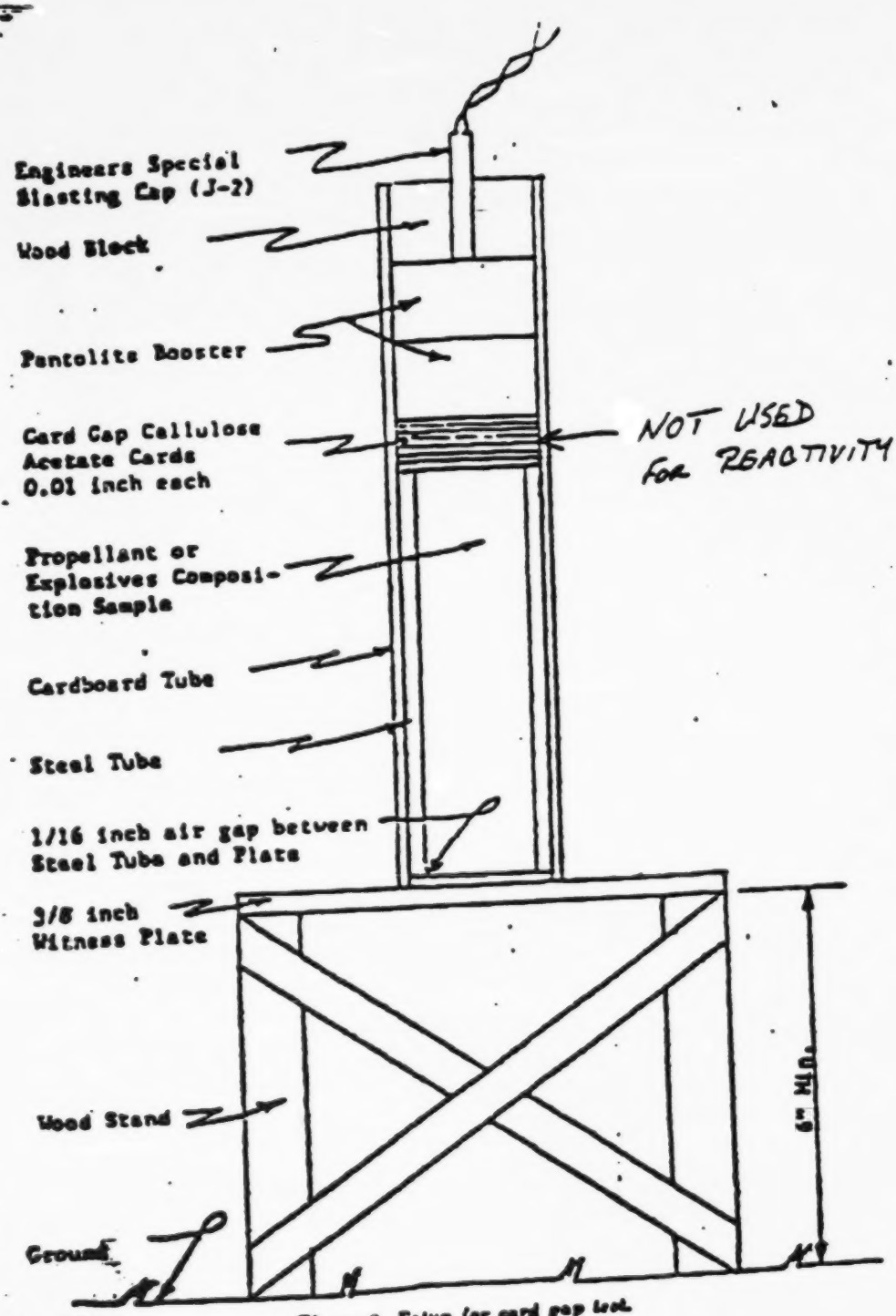

Figure 8. Setup for card gap test.

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